Listing and Technical Evaluation Report™

A Duly Authenticated Report from an Approved Agency

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EStud Structural Insulated Wall Stud

Trade Secret Report Holder:

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CSI Designations:

DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

Section: 06 10 00 - Rough Carpentry

DIVISION: 07 00 00 - THERMAL AND MOISTURE PROTECTION

Section: 07 21 00 - Thermal Insulation

Section: 07 21 13 - Foam Board Insulation

1 Innovative Product Evaluated[1]

1.1 EStud Structural Insulated Wall Stud

2 Product Description and Materials

2.1 The innovative product evaluated in this report is shown in **Figure 1**.

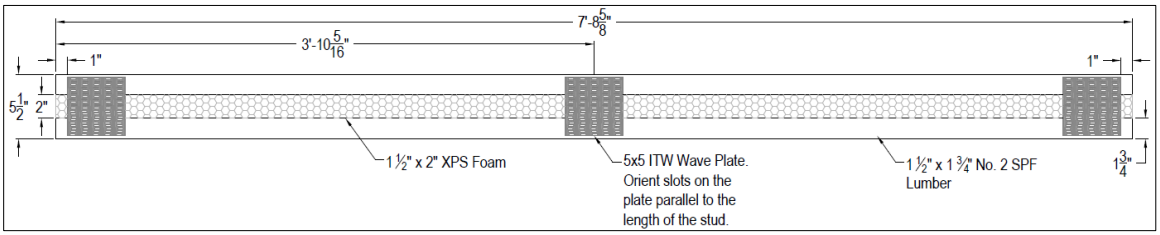

Figure 1. 8' EStud Construction Detail and Specifications

2.2 EStuds are made from a minimum of No. 2 Spruce-Pine-Fir (SPF) lumber and 2" (50.8 mm) extruded polystyrene (XPS) insulation.

2.2.1 Wood species is not limited to SPF.

2.2.2 Any lumber species can be used, as long as the design values of the lumber are equal to or greater than No. 2 SPF.

2.2.3 The lumber is ripped lengthwise into 1¾" wide (44.5 mm) members, and the XPS insulation is placed between sections of cut lumber.

2.2.4 After ripping, the lumber is re-graded to a minimum of #2 grade of the given species.

2.2.5 Lumber re-grading is performed by an American Lumber Standards Committee (ALSC) approved grading agency.

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2.3 The XPS insulation is manufactured in accordance with ASTM C578 prior to EStud manufacture and is adhered to each section of the stud with a heat-resistant adhesive.

2.4 The adhesive used in the manufacturing process is a proprietary adhesive formulated specifically for bonding XPS insulation to wood surfaces.

2.5 Illinois Tool Works Building Components Group (ITWBCG), also known as Alpine, 5" x 5", 20-gauge (36 mil) metal connector plates or equivalent are used to tie the stud assembly together with the lumber acting as tension and compression chords (see **Figure 1** and **Figure 2**).

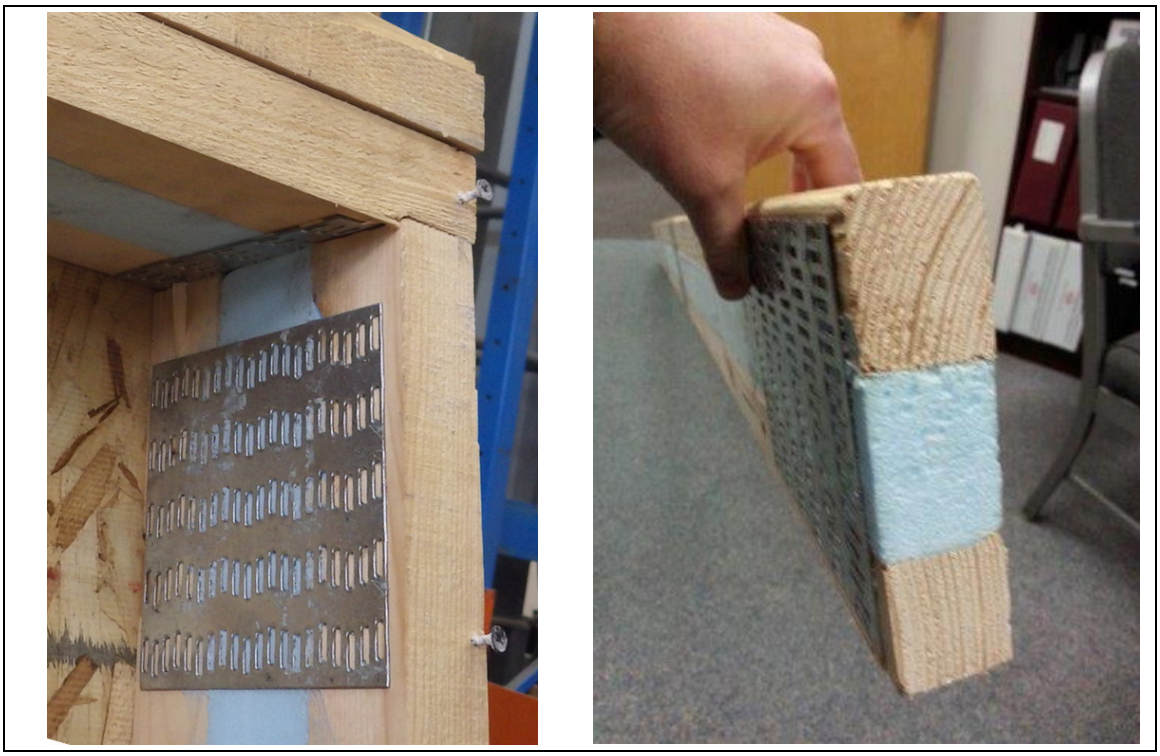

Figure 2. Metal Connector Plate (Left) and EStud Cross Section (Right)

2.5.1 Three (3) metal connector plates are installed on each wide face of the assembly (total 6 plates); one plate is placed at each end, and one is located in the center of the EStud length.

2.5.2 The plates at the ends are located 1" (25.4 mm) from the end of the EStud.

2.5.3 Plates used are ITW wave plates or equivalent.

2.5.4 For top and bottom plate material, 2' x 5" metal connector plates are located 1" from each end and 12" on center along the plate material length.

2.6 *Materials*

2.6.1 *Lumber:*

2.6.1.1 *Grade:*

2.6.1.1.1 No. 2 Spruce-Pine-Fir (SPF)

2.6.1.2 *Thickness:*

2.6.1.2.1 $1^1/_2$" (38.1 mm)

2.6.1.3 *Width:*

2.6.1.3.1 $1^3/_4$" (44.5 mm)

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2.6.1.4 *Lengths:*

2.6.1.4.1 8' (2.44 m)

2.6.1.4.2 9' (2.74 m)

2.6.1.4.3 10' (3.05 m)

2.6.2 *SPS Insulation:*

2.6.2.1 The XPS insulation is manufactured in accordance with ASTM C578.

2.6.3 *Metal Connector Plates:*

2.6.3.1 Metal connector plates used in EStud are manufactured in accordance TPI 1, Chapter 4.

2.6.3.2 Metal connector plates shall be made of 20-gauge (36 mil) ASTM A653, SS Grade 40 structural steel.

2.6.3.3 Metal connector plates shall have a minimum G60 galvanized coating (0.0005" thickness on each side).

2.7 As needed, review material properties for design in **Section 6** and the regulatory evaluation in **Section 8**.

3 Definitions[2]

3.1 New Materials[3] are defined as building materials, equipment, appliances, systems, or methods of construction, not provided for by prescriptive and/or legislatively adopted regulations, known as alternative materials.[4] The design strength and permissible stresses shall be established by tests[5] and/or engineering analysis.[6]

3.2 Duly authenticated reports[7] and research reports[8] are test reports and related engineering evaluations that are written by an approved agency[9] and/or an approved source.[10]

3.2.1 This report utilizes intellectual property and/or trade secrets to create public domain material properties for commercial end-use.

3.2.1.1 This report protects confidential Intellectual Property and trade secrets under the regulation, 18.US.Code.90, also known as Defend Trade Secrets Act of 2016 (DTSA).[11]

3.3 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited. DrJ Engineering, LLC (DrJ) is accredited and listed in the ANAB directory.

3.4 An approved source is *"approved"* when a professional engineer (i.e., Registered Design Professional, hereinafter RDP) is properly licensed to transact engineering commerce. The regulatory authority governing approved sources is the state legislature via its professional engineering regulations.[12]

3.5 Testing and/or inspections conducted for this duly authenticated report were performed by an ISO/IEC 17025 accredited testing laboratory, an ISO/IEC 17020 accredited inspection body, and/or a licensed RDP.

3.5.1 The Center for Building Innovation (CBI) is ANAB[13] ISO/IEC 17025 and ISO/IEC 17020 accredited.

3.6 The regulatory authority shall enforce[14] the specific provisions of each legislatively adopted regulation. If there is a non-conformance, the specific regulatory section and language of the non-conformance shall be provided in writing[15] stating the nonconformance and the path to its cure.

3.7 The regulatory authority shall accept duly authenticated reports from an approved agency and/or an approved source with respect to the quality and manner of use of new materials or assemblies as provided for in regulations regarding the use of alternative materials, designs, or methods of construction.[16]

3.8 ANAB is an International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA) signatory. Therefore, recognition of certificates and validation statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA with the appropriate scope shall be approved.[17] Thus, all ANAB ISO/IEC 17065 duly authenticated reports are approval equivalent,[18] and can be used in any country that is an MLA signatory found at this link: https://iaf.nu/en/recognised-abs/

3.9 Approval equity is a fundamental commercial and legal principle.[19]

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4 Applicable Local, State, and Federal Approvals; Standards; Regulations[20]

4.1 *Local, State, and Federal*

4.1.1 Approved in all local jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured local jurisdictions: Austin, Baltimore, Broward County, Chicago, Clark County, Dade County, Dallas, Detroit, Denver, DuPage County, Fort Worth, Houston, Kansas City, King County, Knoxville, Las Vegas, Los Angeles City, Los Angeles County, Miami, Nashville, New York City, Omaha, Philadelphia, Phoenix, Portland, San Antonio, San Diego, San Jose, San Francisco, Seattle, Sioux Falls, South Holland, St. Louis County, Texas Department of Insurance, and Wichita.[21]

4.1.2 Approved in all state jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured states: California, Florida, New Jersey, Oregon, New York, Texas, Washington, and Wisconsin.[22]

4.1.3 Approved by the Code of Federal Regulations Manufactured Home Construction: Pursuant to Title 24, Subtitle B, Chapter XX, Part 3282.14[23] and Part 3280[24] pursuant to the use of ISO/IEC 17065 duly authenticated reports.

4.1.4 Approved means complying with the requirements of local, state, or federal legislation.

4.2 *Regulations*

4.2.1 *IBC – 18, 21, 24: International Building Code®*

4.2.2 *IRC – 18, 21, 24: International Residential Code®*

4.3 *Standards*

4.3.1 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*

4.3.2 *ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

4.3.3 *ASTM A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

4.3.4 *ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*

4.3.5 *ASTM D198: Standard Test Methods of Static Tests of Lumber in Structural Sizes*

4.3.6 *ASTM E72: Standard Test Methods of Conducting Strength Tests of Panels for Building Construction*

4.3.7 *ASTM E2126: Standard Test Methods for Cyclic (Reversed) load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*

4.3.8 *TPI 1: National Design Standard for Metal-plate-connected Wood Truss Construction*

5 Listed[25]

5.1 Equipment, materials, products, or services included in a List published by a nationally recognized testing laboratory (e.g., CBI), an approved agency (e.g., CBI and DrJ), and/or any approved source (e.g., DrJ), or other organization(s) concerned with product evaluation (e.g., DrJ), that maintains periodic inspection (e.g., CBI) of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

6 Tabulated Properties Generated from Nationally Recognized Standards

6.1 *Prescriptive Provisions*

6.1.1 EStud is an alternative to solid sawn lumber for wall structural members.

6.1.1.1 EStud is an acceptable replacement to nominal 2 x 4 solid sawn lumber in accordance with IBC Section 2308 and IRC Section R602.

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6.1.2 XPS insulation is in accordance with IBC Chapter 26, IBC Section 2603.2, IBC Section 2603.3, IBC Section 2603.4, and IRC Section R303,[26] specifically IRC Section R303.2,[27] IRC Section R303.3,[28] and IRC Section R303.4.[29]

6.1.3 Metal connector plates used are per TPI 1, Chapter 4; TPI 1, Section 4.3.3; and TPI 1, Section 4.3.4.

6.1.4 *Cutting, Notching, and Boring:*

6.1.4.1 Crosscutting EStuds is permitted. Where EStuds are crosscut so that a metal connector plate is not within 3" (76.2 mm) of the EStud end, one of the following shall be done:

6.1.4.1.1 The EStud chords must be nailed to another framing member.

6.1.4.1.2 A metal connector plate shall be field applied to connect the EStud chords, as displayed in **Figure 1**.

6.1.4.2 Notches in structural members (chords or plates) are not permitted.

6.1.4.3 Holes may only be bored in the XPS insulation of EStud and shall not exceed 2" (51 mm) in diameter.

6.1.4.4 Holes shall not be bored in metal connector plates.

6.1.5 EStuds used as structural members of a wall shall be fastened as specified in **Table 1**.

Table 1. Acceptable Fastening Schedule for 2 x 4 EStud

Application[2]	Number and Type of Fastener	Fastener Spacing
Ceiling Joists to Plate (Toenail)	4 (2½" × 0.113")	2 Toe Nails into Each Chord
Rafter or Roof Truss to Plate (Toenail)	4 (3" × 0.128")	2 Toe Nails into Each Chord [1]
Built-up Studs (Face Nail)	(3" × 0.128")	1 Nail into Each Chord at 16" o.c.
Abutting Studs at Intersecting Wall Corners (Face Nail)	(3¼" × 0.131")	1 Nail into Each Chord at 12" o.c.
Double Studs (Face Nail)	(3" × 0.128")	1 Nail into Each Chord at 16" o.c.
Double Top Plates (Face Nail)	(3" × 0.128")	1 Nail into Each Chord at 12" o.c.
Double Top Plates, Minimum 24" Offset of End Joints, Face Nail in Lapped Area	18 (3" × 0.128")	9 Nails into Each Chord
Stud to Plate (Toenail)	4 (2½" × 0.113")	2 Toe Nails into Each Chord
Top or Sole Plate to Stud (End Nail)	2 (3½" × 0.162") or 4 (3" × 0.128")	1 Nail into Each Chord or 2 Nails into Each Chord
Top Plates, Laps at Corners & Intersections (Face Nail)	4 (3" × 0.128")	2 Nails into Each Chord

SI: 1 in = 25.4 mm

1. Where a rafter is fastened to an adjacent parallel ceiling joist in accordance with this schedule, provide two (2) toenails on one (1) side of the rafter and toenails from the ceiling joist to top plate in accordance with this schedule. The toenail on the opposite side of the rafter shall not be required.
2. For all connections, care must be taken to avoid splitting of EStud chords.

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6.1.6 EStuds may be used as a top plate in accordance with IRC Section R602.3.2 and the following:

6.1.6.1 Top plate design shall include 2" x 5" metal plates spaced every 12" (305 mm) o.c., starting no more than 12" (305 mm) from each end of the board to allow the top plates to be cut to custom lengths in the field, while maintaining a metal plate within 12" (305 mm) of each end.

6.1.6.2 Fasteners for EStud connections shall be evenly distributed in each EStud chord (i.e., top plate to stud connections shall have one fastener installed in each EStud chord).

6.1.6.3 Double top plates must be used on all walls.

6.1.7 Use as jack, trimmer, and cripple studs is acceptable, provided at least two (2) metal connector plates are attached on each side of the stud, no less than 1" (25.4 mm) from the ends.

6.1.7.1 If cut in the field to accommodate sizing, EStud must be fastened to a double stud through its face with, at a minimum, 10d (3" x 0.128") nails 16" (610 mm) o.c. into each chord.

6.1.7.2 When used as a jack stud, EStud must be fastened to a king stud.

6.1.7.3 When used as a cripple stud, one (1) nail must be driven through the windowsill plate into each end of the EStud structural members.

6.1.8 Structural sheathing shall be installed on one side of the wall and minimum $^1/_2$" (12.7 mm) Gypsum Wallboard (GWB) or equivalent, on the other side of the wall fastened in accordance with the applicable building code. Sheathing attached to only one side of the wall is not permitted.

6.1.9 Trusses and rafters having a maximum reaction of 2,789 lbs may be placed anywhere on walls with double EStud top plates.

6.1.9.1 For cases where a higher reaction needs to be supported, use of built-up studs fastened in accordance with **Table 1** is permitted with a limit of 2,789 lbs per ply (i.e., 5,578 lbs. per 2-ply built-up stud). In this case, the built-up stud shall be located directly under the applied load.

6.1.9.2 Walls with nominal 2 x 6 lumber top plates shall be in accordance with IRC Section R602.3.2.

6.2 *Engineering Design*

6.2.1 The design provisions for wood construction noted in IBC Section 2301.2 and IRC Section R301.1.3 apply to EStud for Allowable Stress Design (ASD), unless otherwise noted in this report.

6.2.2 *Material Properties:*

6.2.2.1 Reference design values for EStud are specified in **Table 2**.

Table 2. EStud Reference Design Values

Property	Value
F_b	875-psi
F_c	1,150-psi
F_t	450-psi
$F_{c\perp}$	425-psi
EI	8,400,000 lb-in^2
EI_{min}	3,100,000 lb-in^2
SI: 1-psi = 0.00689 MPa	

6.2.2.2 Reference design values for EStud shall be multiplied by the applicable adjustment factors specified in NDS Section 4.3.

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6.2.3 *Design for Axial Loads:*

6.2.3.1 The maximum allowable compression load for EStud is specified in **Table 3**.

6.2.3.2 The maximum allowable compression load is based on perpendicular-to-grain crushing of SPF top and bottom plates.

6.2.3.3 The allowable axial compression for EStud can be calculated using the provisions of NDS Section 3.6 and NDS Section 3.7.

6.2.3.4 For computing the column stability factor, the critical bucking design value, F_{cE}, shall be computed using the following formula:

Equation 1.

$$F_{cE} = \frac{\pi^2 E I_{min}}{A(\ell_e)^2}$$

Where:

EI_{min} = reference stiffness value for column stability calculations

A = total cross-sectional area of EStud (wood only) = 2 x 1.5" x 1.75" = 5.25 in^2 (for SI: 2 x 38.1 mm x 44.5 mm = 3,391 mm^2)

ℓ_e = effective column length

Table 3. EStud Maximum Allowable Compression

EStud Length (ft)	Load (lb)
8	2,789
9	2,511
≤ 10	2,073
SI: 1" = 25.4 mm, 1 lb = 4.45 N	

6.2.4 *Design for Bending:*

6.2.4.1 EStud resists bending using tension and compression stresses in the chord members and bending in the chord member on the side of the EStud to which the loads are applied.

6.2.4.2 The axial stress, f_a, in each member can be computed using the following equation:

Equation 2.

$$f_a = \frac{M}{0.5 \cdot A \cdot d_{eff}}$$

Where:

M = bending moment applied to EStud (lb-in)

A = cross-sectional area of EStud chord = 1.5" x 1.75" = 2.625 in^2 (for SI: 38.1 mm x 44.5 mm = 1,695 mm^2)

d_{eff} = distance from center-to-center of EStud members = 3.75" (95.3 mm)

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6.2.4.3 The bending stress, f_b, in the member on the side of the EStud to which the loads are applied shall be calculated using NDS Section 3.3 as follows:

Equation 3.

$$f_b = \frac{6M}{bd^2}$$

Where:

M = moment due to bending of the EStud member between metal connector plates = $\frac{\omega \ell^2}{12}$

ℓ = center-to-center spacing of metal connector plates

b = width of EStud members = 1.5" (38.1 mm)

d = depth of EStud members = 1.75" (44.5 mm)

6.2.4.4 The combined axial and bending stresses in EStud members shall be checked in accordance with NDS Section 3.9.

6.2.5 *Design for Combined Bending and Axial Loads:*

6.2.5.1 Stresses due to axial loading of EStud shall be added to the axial stress due to bending and checked in accordance with NDS Section 3.9.

6.2.5.2 Allowable axial load values for EStud subject to ASD wind pressures are specified in **Table 4**.

6.2.5.3 Example design calculations for EStud subject to combined bending and axial loads can be found in **Appendix A**.

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Table 4. Allowable Axial Loads and Deflection Ratio for ASD Wind Loading

Stud Spacing (in)	Wall Height (ft)	Allowable Axial Load, lb (Deflection Ratio)							
		ASD Wind Pressure (psf)							
		5	10	15	20	25	30	35	40
12	8	2789 (L/1948)	2555 (L/974)	2263 (L/649)	1985 (L/487)	1718 (L/390)	1457 (L/325)	1202 (L/278)	951 (L/244)
	9	2160 (L/1352)	1798 (L/676)	1464 (L/451)	1144 (L/338)	833 (L/270)	529 (L/225)	229 (L/193)	–
	10	1622 (L/976)	1214 (L/488)	832 (L/325)	463 (L/244)	102 (L/195)	–	–	–
16	8	2764 (L/1461)	2358 (L/731)	1985 (L/487)	1630 (L/365)	1287 (L/292)	951 (L/244)	621 (L/209)	295 (L/183)
	9	2035 (L/1014)	1574 (L/507)	1144 (L/338)	731 (L/253)	328 (L/203)	–	–	–
	10	1482 (L/732)	958 (L/366)	463 (L/244)	–	–	–	–	–
24	8	2484 (L/974)	1878 (L/487)	1321 (L/325)	787 (L/244)	268 (L/195)	–	–	–
	9	1732 (L/676)	1044 (L/338)	400 (L/225)	–	–	–	–	–
	10	1152 (L/488)	369 (L/244)	–	–	–	–	–	–
SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1-psf = 0.0479 kN/m^2									

6.3 For applications outside of the scope of the applicable code, consult the manufacturer installation instructions or an RDP.

6.4 Alternative techniques shall be permitted in accordance with accepted engineering practice and experience. These provisions for the use of alternative materials, designs, and methods of construction are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed herein. This includes, but is not limited to, the following areas of engineering: mechanics of materials, structures, building science, and fire science.

7 Certified Performance[30]

7.1 All construction methods shall conform to accepted engineering practices to ensure durable, livable, and safe construction and shall demonstrate acceptable workmanship reflecting journeyman quality of work of the various trades.[31]

7.2 The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur.[32]

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8 Regulatory Evaluation and Accepted Engineering Practice

8.1 EStud Structural Insulated Wall Stud complies with the following legislatively adopted regulations and/or accepted engineering practice for the following reasons:

8.1.1 EStud was evaluated to determine its applicability for use as an alternative material where nominal 2 x 4 solid sawn lumber is specified in accordance with the IBC and IRC.

8.1.2 EStud testing and analysis was conducted to determine its compression, flexural strengths, and flexural stiffness.

8.1.3 EStud was examined for the following:

8.1.3.1 Use as an alternative material to that described in IBC Chapter 23, in particular, compliance with requirements for the design and construction of wood-based products as described in IBC Section 2302.1 for ASD and Load and Resistance Factor Design (LRFD).

8.1.3.2 Compliance with IBC Section 2308, IBC Section 2304, and IRC Chapter 6 for conventional light-frame construction applications.

8.1.3.3 Use as an alternative material and method of construction in compliance with IBC Section 104.2.3[33] and IRC Section R104.2.2.[34]

8.2 When used in an application that exceeds the limits of IBC Section 2308 or IRC Section R301, an engineered design shall be submitted in accordance with IRC Section R301.1.3 and this report.

8.3 Any building code, regulation and/or accepted engineering evaluations (e.g., research reports, duly authenticated reports, etc.) that are conducted for this Listing were performed by DrJ, which is an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDP or approved sources. DrJ is qualified[35] to practice product and regulatory compliance services within its scope of accreditation and engineering expertise,[36] respectively.

8.4 Engineering evaluations are conducted with DrJ's ANAB accredited ICS code scope of expertise, which is also its areas of professional engineering competence.

9 Installation

9.1 Installation shall comply with the approved construction documents, the manufacturer installation instructions, this report, and the applicable building code.

9.2 In the event of a conflict between the manufacturer installation instructions and this report, contact the manufacturer for counsel on the proper installation method.

9.3 *Installation Procedure*

9.3.1 EStud is pre-assembled and designed to be used as a direct replacement of nominal 2 x 4 (38 mm x 89 mm) solid sawn lumber as wall studs and top plates.

9.3.2 Install EStud in the same manner as solid sawn lumber, except as noted herein:

9.3.2.1 For IBC Section 2308 and the IRC, install in accordance with the provisions therein, except as noted in this report.

9.3.2.2 For engineered design, walls shall be designed in accordance with the IBC and the referenced standards therein using the material properties and design limitations as noted in **Section 6**.

9.4 Design of connections using EStud shall be in accordance with the NDS.

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10 Substantiating Data

10.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:

10.1.1 Bending testing of EStuds and EStud Top Plates in accordance with ASTM D198

10.1.2 Cyclic shear resistance testing of WSP shear walls with EStud framing in accordance with ASTM E2126

10.1.3 Compression testing of EStuds in accordance with ASTM E72

10.2 Information contained herein may include the result of testing and/or data analysis by sources that are approved agencies, approved sources, and/or an RDP. Accuracy of external test data and resulting analysis is relied upon.

10.3 Where applicable, testing and/or engineering analysis are based upon provisions that have been codified into law through state or local adoption of regulations and standards. The developers of these regulations and standards are responsible for the reliability of published content. DrJ's engineering practice may use a regulation-adopted provision as the control. A regulation-endorsed control versus a simulation of the conditions of application to occur establishes a new material as being equivalent to the regulatory provision in terms of quality, strength, effectiveness, fire resistance, durability, and safety.

10.4 The accuracy of the provisions provided herein may be reliant upon the published properties of raw materials, which are defined by the grade mark, grade stamp, mill certificate, or duly authenticated reports from approved agencies and/or approved sources provided by the supplier. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this duly authenticated report, may be dependent upon published design properties by others.

10.5 *Testing and Engineering Analysis*

10.5.1 The strength, rigidity, and/or general performance of component parts and/or the integrated structure are determined by suitable tests that simulate the actual conditions of application that occur and/or by accepted engineering practice and experience.[37]

10.6 Where additional condition of use and/or regulatory compliance information is required, please search for EStud on the DrJ Certification website.

11 Findings

11.1 As outlined in **Section 6**, EStud has performance characteristics that were tested and/or meet applicable regulations. In addition, they are suitable for use pursuant to its specified purpose.

11.2 When used and installed in accordance with this duly authenticated report and the manufacturer installation instructions, EStud shall be approved for the following applications:

11.2.1 For use as an alternative to nominal 2 x 4 (38 mm x 89 mm) solid sawn lumber.

11.3 Unless exempt by state statute, when EStud is to be used as a structural and/or building envelope component in the design of a specific building, the design shall be performed by an RDP.

11.4 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available by contacting Lester Wilkens.

11.5 IBC Section 104.2.3[38] (IRC Section R104.2.2[39] and IFC Section 104.2.3[40] are similar) in pertinent part state:

> **104.2.3 Alternative Materials, Design and Methods of Construction and Equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative is not specifically prohibited by this code and has been approved.

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11.6 **Approved:**[41] Building regulations require that the building official shall accept duly authenticated reports.[42]

11.6.1 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited.

11.6.2 An approved source is *"approved"* when an RDP is properly licensed to transact engineering commerce.

11.6.3 Federal law, Title 18 US Code Section 242, requires that, where the alternative product, material, service, design, assembly, and/or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved. Denial without written reason deprives a protected right to free and fair competition in the marketplace.

11.7 DrJ is a licensed engineering company, employs licensed RDPs and is an ANAB Accredited Product Certification Body – Accreditation #1131.

11.8 Through the IAF Multilateral Arrangement (MLA), this duly authenticated report can be used to obtain product approval in any jurisdiction or country because all ANAB ISO/IEC 17065 duly authenticated reports are equivalent.[43]

12 Conditions of Use

12.1 As defined in **Section 6**, where material and/or engineering mechanics properties are created for load resisting design purposes, the resistance to the applied load shall not exceed the ability of the defined properties to resist those loads using the principles of accepted engineering practice.

12.2 As listed herein, EStud shall not be used:

12.2.1 As a bottom plate where fixture to a sill plate and anchor bolts is required.

12.2.2 As a stud pack where hold-downs are required for engineered design.

12.3 The manufacturer published installation instructions shall be available at the jobsite at all times during installation.

12.4 EStud is a suitable alternative to 2 x 4 sawn lumber as permitted by the codes listed in **Section 4**, subject to the following conditions:

12.4.1 Metal connector plates must not be removed.

12.4.1.1 If metal connector plates are missing upon arrival, not applied correctly from the distributor, or fall off during installation, the stud shall be replaced.

12.4.2 The maximum wall height for EStud is 10' (3.05 m).

12.4.3 Increases for duration of load shall be in accordance with the limitations of the applicable building code for sawn lumber.

12.4.4 Creep factors applicable to sawn lumber may be applied to this product in accordance with the applicable building code.

12.5 When required by adopted legislation and enforced by the building official, also known as the Authority Having Jurisdiction (AHJ) in which the project is to be constructed:

12.5.1 Any calculations incorporated into the construction documents shall conform to accepted engineering practice and, when prepared by an approved source, shall be approved when signed and sealed.

12.5.2 This report and the installation instructions shall be submitted at the time of permit application.

12.5.3 At a minimum, this innovative product shall be installed per **Section 9**.

12.5.4 The review of this report by the AHJ shall comply with IBC Section 104.2.3.2 and IBC Section 105.3.1.

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12.5.5 This innovative product has an internal quality control program and a third party quality assurance program in accordance with IBC Section 104.7.2, IBC Section 110.4, IBC Section 1703, IRC Section R104.7.2, and IRC Section R109.2.

12.5.6 The application of this innovative product in the context of this report is dependent upon the accuracy of the construction documents, implementation of installation instructions, inspection as required by IBC Section 110.3, IRC Section R109.2, and any other regulatory requirements that may apply.

12.6 The approval of this report by the AHJ shall comply with IBC Section 1707.1, where legislation states in part, *"the building official shall make, or cause to be made, the necessary tests and investigations; or the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in Section 104.2.3"*, all of IBC Section 104, and IBC Section 105.3.

12.7 Design loads shall be determined in accordance with the regulations adopted by the jurisdiction in which the project is to be constructed and/or by the building designer (i.e., owner or RDP).

12.8 The actual design, suitability, and use of this report for any particular building, is the responsibility of the owner or the authorized agent of the owner.

13 Identification

13.1 EStud Structural Insulated Wall Stud, as listed in **Section 1.1**, is identified by a label on the board or packaging material bearing the manufacturer name, product name, this report number, and other information to confirm code compliance.

13.2 Additional technical information can be found by contacting Lester Wilkens at lbwilkens@hotmail.com.

14 Review Schedule

14.1 This report is subject to periodic review and revision. For the latest version, visit www.drjcertification.org.

14.2 For information on the status of this report, please contact DrJ Certification.

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Appendix A
EStud Example Calculation

Material Properties of EStud:

The EStud uses SPF lumber graded as No.2.

$F_c := 1150\ psi$ $F_b := 875\ psi$ $F_t := 450\ psi$

$C_{fc} := 1.15$ $C_{fb} := 1.5$ $C_{ft} := 1.5$

$F_{c_perp} := 425\ psi$

$EI := 8400000\ lbf \cdot in^2$

$EI_{min} := 3100000\ lbf \cdot in^2$

Section Properties of EStud:

$d_1 := 1.75\ in$ Wide face dimension.

$d_2 := 1.5\ in$ Narrow face dimension.

$d_{eff} := 3.75\ in$ Moment arm between members.

$A := d_1 \cdot d_2 \cdot 2 = 5.25\ in^2$ Area of EStud.

$l_1 := 92.625\ in$ Height of EStud.

$l_3 := \frac{l_1 - 7\ in}{2} = 42.813\ in$ On center spacing of truss plates.

Calculate allowable stresses for the EStud:

$C_D := 1.6$

$C_r := 1.5$ Repetitive member factor for studs is 1.5 per SDPWS Section 3.1.1 for studs spaced 16" o.c. or less. For stud spacing greater than 16" o.c., the repetitive member factor is 1.15 per the NDS.

$C_b := \frac{d_2 + 0.375\ in}{d_2} = 1.25$

$F_t' := F_t \cdot C_D \cdot C_{ft} = 1080\ psi$

$F_b' := F_b \cdot C_D \cdot C_{fb} \cdot C_r = 3150\ psi$

$F_{c_star} := F_c \cdot C_{fc} \cdot C_D = 2116\ psi$

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$c := 0.8$ Constant for sawn lumber.

$K := 1.0$ Buckling effective length factor for pinned-pinned column.

$$F_{cE} := \frac{\pi^2 \, EI_{min}}{A \, (K \cdot l_1)^2} = 679 \; psi$$

The equation for the Euler buckling stress given in NDS Section 3.7.1 is rearranged to show the term EI.

$$C_p := \frac{1 + \left(\frac{F_{cE}}{F_{c.star}}\right)}{2 \cdot c} - \sqrt{\left(\frac{1 + \left(\frac{F_{cE}}{F_{c.star}}\right)}{2 \cdot c}\right)^2 - \frac{\left(\frac{F_{cE}}{F_{c.star}}\right)}{c}} = 0.296$$

$$F_c' := F_{c.star} \cdot C_p = 627 \; psi$$

Combined Axial and Wind Loads on EStud:

$p := 30 \; psf$ Wind pressures on wall. For combined axial and bending checks, MWFRS wind loads may be used. For checking bending stresses independent of axial stresses, C&C wind loads shall be used.

$Spacing_{studs} := 16 \; in$

$$S := \frac{d_2 \cdot d_1^2}{6} = 0.766 \; in^3$$

$w := 0.75 \; p \cdot Spacing_{studs} = 30 \; plf$ A 0.75 factor is applied to the wind load in accordance with load combination 6a in Section 2.4.1 of ASCE 7-10.

$$M_{mem} := \frac{w \cdot l_3^2}{12} = 382 \; lbf \cdot in$$

For bending of the individual members of the EStud, the equation for a beam fixed at each end is used.

$$f_b := \frac{M_{mem}}{S} = 499 \; psi$$

$$M_{stud} := \frac{w \cdot l_1^2}{8} = 2681 \; lbf \cdot in$$

For bending of the entire EStud, the equation for a beam pinned at each end is used.

$$f_{a_bend} := \frac{M_{stud}}{\left(\frac{A}{2}\right) \cdot d_{eff}} = 272 \; psi$$

Calculate the axial stress in each member of the EStud due to bending as the moment divided by the distance between members and the area of the member.

$P := 951 \; lbf$ Axial load on the Estud is selected to result in a CSI of 1.0.

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$$P_{c_perp} := F_{c_perp} \cdot C_b \cdot A = 2789\ lbf \quad > \quad P = 951\ lbf$$

$$f_{a_comp} := \frac{P}{A} = 181\ psi$$

For positive wind pressures:

$$f_c := f_{a_bend} + f_{a_comp} = 454\ psi \quad < \quad F_{cE} = 679\ psi \quad \text{and} < \quad F_c' = 627\ psi \quad \textbf{OK}$$

$$\left(\frac{f_c}{F_c'}\right)^2 + \frac{f_b}{F_b' \cdot \left(1 - \frac{f_c}{F_{cE}}\right)} = 1.00 \quad \textbf{OK}$$

$$f_{c_in} := f_{a_comp} - f_{a_bend} = -91\ psi \quad < \quad F_t' = 1080\ psi \quad \textbf{OK}$$

For negative wind pressures:

$$f_t := f_{a_comp} - f_{a_bend} = -91\ psi \quad < \quad F_t' = 1080\ psi \quad \textbf{OK}$$

$$\frac{f_t}{F_t'} + \frac{f_b}{F_b'} = 0.07 \quad < 1.00 \quad \textbf{OK}$$

$$f_c := f_{a_comp} + f_{a_bend} = 454\ psi \quad < \quad F_{cE} = 679\ psi \quad \text{and} < \quad F_c' = 627\ psi \quad \textbf{OK}$$

Check Deflection Limit for EStud:

$$\Delta := \frac{5 \cdot \left(\frac{w}{0.75}\right) \cdot l_1^{\,4}}{384 \cdot EI} = 0.38\ in$$

Note that the wind load may be taken as 0.7 times the C&C load for the purpose of determining the stud deflection per IRC Table R301.7 and IBC Table 1604.3.

$$\frac{l_1}{\Delta} = 244 \quad > 240$$

OK (for gypsum board wall finish)

Summary of Design Calculations for EStud:

The EStud has an axial load capacity of 951 lbs for an 8' tall wall with a wind pressure of 30 psf.

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Notes

1 For more information, visit drjcertification.org or call us at 608-310-6748.

2 Capitalized terms and responsibilities are defined pursuant to the applicable building code, applicable reference standards, the latest edition of TPI 1, the NDS, AISI S202, US professional engineering law, Canadian building code, Canada professional engineering law, Qualtim External Appendix A: Definitions/Commentary, Qualtim External Appendix B: Project/Deliverables, Qualtim External Appendix C: Intellectual Property and Trade Secrets, definitions created within Design Drawings and/or definitions within Reference Sheets. Beyond this, terms not defined shall have ordinarily accepted meanings as the context implies. Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

3 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1702

4 Alternative Materials, Design and Methods of Construction and Equipment: The provisions of any regulation code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by a regulation. Please review https://www.justice.gov/atr/mission and https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3

5 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.2:~:text=the%20design%20strengths%20and%20permissible%20stresses%20shall%20be%20established%20by%20tests

6 The design strengths and permissible stresses of any structural material shall conform to the specifications and methods of design of accepted engineering practice. https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.1:~:text=Conformance%20to%20Standards-,The%20design%20strengths%20and%20permissible%20stresses,-of%20any%20structural

7 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1:~:text=the%20building%20official%20shall%20make%2C%20or%20cause%20to%20be%20made%2C%20the%20necessary%20tests%20and%20investigations%3B%20or%20the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies%20in%20respect%20to%20the%20quality%20and%20manner%20of%20use%20of%20new%20materials%20or%20assemblies%20as%20provided%20for%20in%20Section%20104.2.3.

8 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4.2

9 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_agency

10 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_source

11 https://www.law.cornell.edu/uscode/text/18/1832 (b) Any organization that commits any offense described in subsection (a) shall be fined not more than the greater of $5,000,000 or 3 times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided. The federal government and each state have a public records act. To follow DTSA and comply state public records and trade secret legislation requires approval through ANAB ISO/IEC 17065 accredited certification bodies or approved sources. For more information, please review this website: Intellectual Property and Trade Secrets.

12 https://www.nspe.org/resources/issues-and-advocacy/professional-policies-and-position-statements/regulation-professional AND https://apassociation.org/list-of-engineering-boards-in-each-state-archive/

13 https://www.cbitest.com/accreditation/

14 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.1:~:text=directed%20to%20enforce%20the%20provisions%20of%20this%20code

15 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3 AND https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#105.3.1

16 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

17 https://iaf.nu/en/about-iaf-mla/#:~:text=Once%20an%20accreditation%20body%20is%20a%20signatory%20of%20the%20IAF%20MLA%2C%20it%20is%20required%20to%20recognise%20certificates%20and%20validation%20and%20verification%20statements%20issued%20by%20conformity%20assessment%20bodies%20accredited%20by%20all%20other%20signatories%20of%20the%20IAF%20MLA%2C%20with%20the%20appropriate%20scope

18 True for all ANAB accredited product evaluation agencies and all International Trade Agreements.

19 https://www.justice.gov/crt/deprivation-rights-under-color-law AND https://www.justice.gov/atr/mission

20 Unless otherwise noted, the links referenced herein use un-amended versions of the 2024 International Code Council (ICC) 2024 International Code Council (ICC) model codes as foundation references. Mississippi versions of the IBC 2024 and the IRC 2024 are un-amended. This material, product, design, service and/or method of construction also complies with the 2000-2012 versions of the referenced codes and the standards referenced therein. As pertinent to this technical and code compliance evaluation, CBI and/or DrJ staff have reviewed any state or local regulatory amendments to assure this report is in compliance.

21 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by the local jurisdiction. https://up.codes/codes/general

22 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by state. https://up.codes/codes/general

23 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3282/subpart-A/section-3282.14

24 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

25 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#p-3280.2(Listed%20or%20certified); https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#listed AND https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#labeled

26 2021 IRC Section R316

27 2021 IRC Section R316.2

28 2021 IRC Section R316.3

29 2021 IRC Section R316.4

30 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4

31 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=All%20construction%20methods%20shall%20be%20in%20conformance%20with%20accepted%20engineering%20practices%20to%20insure%20durable%2C%20livable%2C%20and%20safe%20housing%20and%20shall%20demonstrate%20acceptable%20workmanship%20reflecting%20journeyman%20quality%20of%20work%20of%20the%20various%20trades

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[32] https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=The%20strength%20and%20rigidity%20of%20the%20component%20parts%20and/or%20the%20integrated%20structure%20shall%20be%20determined%20by%20engineering%20analysis%20or%20by%20suitable%20load%20tests%20to%20simulate%20the%20actual%20loads%20and%20conditions%20of%20application%20that%20occur

[33] 2021 IBC Section 104.11

[34] 2021 IRC Section R104.11

[35] Qualification is performed by a legislatively defined Accreditation Body. ANSI National Accreditation Board (ANAB) is the largest independent accreditation body in North America and provides services in more than 75 countries. DrJ is an ANAB accredited product certification body.

[36] https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?prgID=1&orgID=2125&statusID=4#:~:text=Bill%20Payment%20Date-,Accredited%20Scopes,-13%20ENVIRONMENT.%20HEALTH

[37] See Code of Federal Regulations (CFR) Title 24 Subtitle B Chapter XX Part 3280 for definition: https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

[38] 2021 IBC Section 104.11

[39] 2021 IRC Section R104.11

[40] 2018: https://up.codes/viewer/wyoming/ifc-2018/chapter/1/scope-and-administration#104.9 AND 2021: https://up.codes/viewer/wyoming/ibc-2021/chapter/1/scope-and-administration#104.11

[41] Approved is an adjective that modifies the noun after it. For example, Approved Agency means that the Agency is accepted officially as being suitable in a particular situation. This example conforms to IBC/IRC/IFC Section 201.4 (https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#201.4) where the building code authorizes sentences to have an ordinarily accepted meaning such as the context implies.

[42] https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

[43] Multilateral approval is true for all ANAB accredited product evaluation agencies and all International Trade Agreements.

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